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PRELIMINARY TESTS OF SOME NEW FIRE RETARDANTS

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The growing use of the fire retardant sodium calcium borate has prompted a wave of inquiry. Fire control officers and commercial developers of fire retardant and fire-proofing chemicals ask these questions: "Are we using the best fire retardant available?" "What about testing other materials?" Samples of several new materials and chemicals have been received for testing by the Experiment Station.

Preliminary laboratory screening of some of these samples has shown some promising candidates. None, however, meets all the requirements for an ideal retardant, and even the better new materials need a good deal of study before they can be recommended. Their abrasiveness and other physical properties are unknown, and field trials are essential to learn if performance on fires bears out the laboratory findings.

Essentially the laboratory procedure[1] compares the ignition time and the fire intensity of fuels treated with fire retardant against those of similar untreated fuels. We did not test all of the materials sent to us. If enough definite information was available, we rejected materials that would be:

1. Prohibitive in cost.
2. Corrosive to pump and tank metals.
3. Toxic to animals and plants.

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[1] Laboratory tests and procedures were those described in: Fire Retardant I. Firestop Progress Report No. 4, 12pp., illus., Feb. 15, 1955.

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Results

The test materials had a wide range in ability to increase ignition time and reduce fire intensity (tables 1 and 2). As was shown in the earlier laboratory tests,[2] those retardants that increase ignition time the most do not necessarily reduce fire intensity the most. In the current study, sodium calcium borate was the most effective in increasing the time for ignition over the range of test temperatures but was less effective in reducing fire intensity than bentonites or the California Flameproofing Company compound.

Table 1.--Ignition time of various retardant-treated fuels as percent of ignition time of untreated fuels, at specified test temperatures

Retardant	900°F.	1040°F.	1260°F.	1360°F.	1460°F.
Sodium calcium borate	119.3	135.0	138.7	150.8	162.0
Bentonite-325	134.5	134.7	123.0	119.3	126.0
Bentonite-250	130.2	122.8	123.8	117.2	120.3
Water-cote	107.5	111.0	116.0	119.0	140.6
California Flameproofing Company compound	104.4	106.6	112.2	115.7	90.2
Borax and boric acid compound	97.5	107.7	110.7	120.8	119.4

Table 2.--Fire intensity of fires burning retardant-treated fuels as percent of intensity of fires burning untreated fuels

Retardant	Total intensity	Peak intensity
Sodium calcium borate	63.6	79.0
Bentonite-325	10.3	39.0
Bentonite-250	7.0	37.4
Water-cote	80.3	90.0
California Flameproofing Company compound	36.4	69.7

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[2] Fire Retardant I. Firestop Progress Report No. 4, Feb. 15, 1955.

All test materials were originally in powder form. When mixed with water all except two compounds went into relatively stable suspensions. The California Flameproofing Company and borax and boric acid compounds went into solution.

All acted mainly by insulating the test fuel and preventing free access of oxygen to the fuel surface. Some chemical reaction also occurred when fuels treated with the two dissolved compounds were exposed to heat.

Conclusion

It is generally agreed that the ideal fire retardant should have the following characteristics in addition to being effective as a retardant:

1. Reasonably inexpensive.
2. Mixes into suspension or solution easily.
3. Remains in suspension over a long period of time.
4. Not toxic to animals or plants.
5. Not corrosive to metals used in fire equipment.
6. Adheres well to any type of vegetation.
7. Will not crack and crumble under extreme drying conditions.
8. Does not increase specific gravity excessively.
9. Requires small amount of material per gallon of water to give proper slurry, thus minimizing handling and transportation costs.
10. Not excessively abrasive to mixing and pumping equipment.
11. Easily removed from any surface by washing with water.
12. Readily available in large quantities in many areas.
13. Not a desiccant to vegetation.

Sodium calcium borate has already demonstrated that it is an effective fire retardant[3] but is definitely weak in the following:

1. Cost per gallon of slurry is relatively high.
2. Is a soil sterilant in heavy concentrations.
3. Requires relatively large amount of material per gallon of water.
4. Abrasive to conventional water pumps.

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[3] A chemical fire retardant.....results of field trials using sodium calcium borate on forest fires in 1956. Miller, H. R., and Wilson, C. C., U. S. Forest Service, California Forest and Range Experiment Station. Technical Paper 15, 20pp., illus. 1957.

The bentonites meet most of the desired requirements. We still need to know how they will adhere to some types of vegetation and how abrasive they are to pumps. At this time we do not have the information necessary to classify the California Flameproofing Company compound and the borax and boric acid compound. The manufacturers of Water-cote have reformulated their product and the new formulation will be tested soon. The basic material of Water-cote gives it many desirable characteristics.

Our objective is to get as close to the ideal as we can, as soon as we can, in order to secure a fire retardant which has maximum effectiveness at a minimum cost. Further testing of retardants mentioned in this report and of new materials in the laboratory and on wildfires may give us the object of our search.

Note: In order that the information in our publications may be more intelligible, it is sometimes necessary to use trade names of products or equipment rather than complicated descriptive or chemical identifications. In so doing it is unavoidable in some cases that similar products on the market under other trade names may not be cited. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned.